

821 MISCELLANEOUS

821.01 WATER

Water for use in portland cement concrete or mortar shall be free from injurious amounts of oil, acid, alkali, vegetable substance or other deleterious matter and shall be tested in accordance with AASHTO T 26. "Quality of Water To Be Used in Concrete". Use of river and stream water is prohibited. On District contracts, the Water and Sewer Utilities Administration representative will issue permits for attachment to public hydrants for the use of water.

821.02 BEARING PADS

(A) PREFORMED FABRIC PADS. Preformed fabric pads shall be composed of multiple layers of 8-ounce cotton duck impregnated and bound with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the lamination of not less than 10,000 pounds per square inch without detrimental reduction in thickness or extrusion.

(B) ELASTOMERIC BEARING PADS. Elastomeric bearing pads less than 1/2 inch in thickness shall be either laminated or all elastomer. Pads 1/2 inch or over in thickness shall be laminated. Stacking of individually laminated pads to attain thicknesses over 1/2 inch will not be permitted; however, cold bonding of individual laminated pads will be permitted providing the bond between the pads has a minimum peel strength of 20 pounds per inch. Laminated pads shall consist of alternate layers of elastomer and metal or fabric reinforcement bonded together. The top and bottom layers of reinforcement shall be uniformly covered with a maximum of 1/8 inch of elastomer. The edges of metal reinforcement shall be fully coated with elastomer not more than 1/4 inch in thickness.

Elastomeric bearing pads, elastomer and reinforcement shall conform to the requirements of AASHTO M 251, except that the elastomer shall show no cracks when subjected to ozone resistance at 20 percent strain for 100 hours \pm 2°F in accordance with ASTM D 1149, except 100 \pm 20 parts per 100,000,000 ozone.

(C) NEOPRENE PADS. Neoprene pads shall be cast in molds under pressure and heat. Pads shall meet the requirements listed herein. A certification from the manufacturer shall be required that includes test results showing conformance to these specification requirements.

Grade (Durometer)	50	60	70
Original Properties			
Hardness, STM D 676	50 + -5	60 + -5	70 + -5
Min. Tensile Strength, psi, ASTM D 412	2500	2500	2500
Min. Elongation at Break, % 573, 70 hrs at 212°F	400	350	300
Hardness, Max, points change	0 to +15	0 to +15	0 to +15
Max. Tensile Strength			

Change, %	+/-15	+/-15	
Max. Elongation at Break			
Change, %	-40	-40	-40
1 PPM Ozone in Air by volume at 20 Strain and 100+/-2°F, ASTM	No Cracks	No Cracks	No Cracks
Compression Set for 22 hrs at 158F, ASTM D 395, Method B, Max Percent	25	25	25
Max. Youngs Modulus at -40°F, psi, ASTM D 797	10,000	10,000	10,000
Min. Tear, Pounds per linear inch, ASTM D 624, Die C	225	225	225
Laminated	Yes		No

821.03 LIME

(A) Hydrated lime used as an anti strip additive in bituminous mixtures shall conform to the requirements of AASHTO M 216, Type I, Grade A.

(B) Lime used in seeding shall consist of an agricultural calcic or dolomitic ground limestone containing at least 85 percent of total calcium and magnesium carbonates. Limestone shall be per standards of the Association of Official Agricultural Chemists and ASTM C 51.

Lime shall meet following sieve analysis: At least 40 percent passing a No. 100 sieve, and at least 95 percent passing a No. 8 sieve.

(C) Crownvetch lime for agriculture use shall be ground limestone with 90 percent passing a 20 mesh screen and 40-50 percent passing 100 mesh screen. It shall contain a minimum of 85 percent total carbohydrates.

(D) Hydrated lime used in masonry mortar shall meet the requirements of AASHTO M 216, Type I or II, as specified in the Contract.

(E) Hydrated lime for use in masonry mortar for glazed ceramic wall tile shall conform to the requirements of ASTM C 207, Type S.

821.04 PRECAST PCC SEWER-WATER UNITS

Precast PCC sewer and water manhole and casing units, basin tops with cover, grade rings, drip stones and cheek blocks shall be as per AASHTO M 199.

821.05 ADAPTER RINGS

(A) **CONCRETE.** Concrete for concrete adapter rings shall meet the requirements of PCC mix design as specified in 817. The rings shall be of the size and dimensions as indicated on the plans.

(B) CAST IRON. See 815.04.

821.06 ANCHOR BOLTS

(A) PAVING. Anchor bolts shall be 9/16 inch in diameter and at least 11 inches long. The bolt shall be equipped with an expansion device on one end and a hook on the other. The bolts shall meet the requirements of AASHTO M 31, plain bars, Grade 40.

(B) MISCELLANEOUS. Self-anchoring bolts shall be per FSS FF-S-325 for Group I, Type 2, Styles 1 and 2; Group II, Type 4, Class 1 and 2; or Group III, Types 1 and 2. Bolts shall be galvanized per AASHTO M 232 and be capable of withstanding a proof test load 4 times greater than the design working load.

821.07 MANHOLE STEPS

Manhole steps shall be reinforced plastic steps composed of ASTM A 615, Grade 60 reinforcing bar (#4) completely encapsulated in copolymer polypropylene per ASTM D 2146, Type II, Grade 43758, as made by M. A. Industries, Inc., Peachtree City, Georgia, Model PSI-B for brick selections and model PSI-PF for concrete riser sections, or approved equivalent reinforced plastic step.

821.08 GRANULATED IRON BLAST FURNACE SLAG

Granulated slag when used as a substitute for portland cement shall conform to the requirements of ASTM C 989, Grade 120. When blended with portland cement, the blend shall meet the requirements of 801.03, Type 1S. Certification requirements of ASTM C 989 apply.

821.09 FLY ASH

(A) FLY ASH USED FOR SOIL-AGGREGATE STABILIZATION. Fly ash and other pozzolans shall conform to the requirements of ASTM C 593, when used with lime and a mixture of soil, soil aggregate, or aggregate.

(B) FLY ASH USED IN PORTLAND CEMENT CONCRETE. Fly ash used in portland cement concrete shall meet the requirements of AASHTO M 295, Class C or Class F, except the maximum loss on ignition for Class C and F shall be 4.0 percent. The supplementary requirements of Table 2A shall apply when required by the Engineer. When blended with portland cement, the blend shall meet the requirements of 801.03, Type 1P.

Written certification is required that all pozzolan meets these specifications for physical and chemical requirements.

821.10 EPOXY

(A) GENERAL. Epoxy for use as a binder with aggregates or for bonding hardened concrete, plastic concrete, wood, metals, masonry, and most plastics shall conform to the requirements of ASTM C 881-90 or AASHTO M 235-91 for the Type, Grade, Class, and color specified. A certificate of compliance shall be required for each epoxy used. Types I and II epoxy shall not be used. This specification shall not be

used for bonding surfaces of polyethylene, TFE, fluorocarbon, cellophane, or surfaces which are greased or waxed. The stoichiometric ratio of epoxy base and hardener shall be by volume and shall not exceed a 4 to 1 ratio.

The following guide shall be used for determining acceptable epoxies for use:

Type III - For use in bonding skid-resistant materials to hardened concrete, and as a binder in epoxy mortars or epoxy concretes used on traffic bearing surfaces (or surfaces subject to thermal or mechanical movements).

Type IV - For use in load bearing applications for bonding hardened concrete to hardened concrete and other materials and as a binder for epoxy mortars and concretes.

Type V - For use in load bearing applications for bonding freshly mixed concrete to hardened concrete.

Type VI - For bonding and sealing segmental precast elements with internal tendons and for span-by-span erection when temporary post tensioning is applied.

Type VII - For use as a nonstress carrying sealer for segmental precast elements when temporary post tensioning is not applied as in span-by span erection.

Grade 1 - Low Viscosity: For use where a fluid epoxy is required for application such as for mixing and penetration.

Grade 2 - Medium Viscosity: For use on surfaces not requiring penetration such as bonding new to old concrete.

Grade 3 - Non-sagging consistency.

Class A: For use on surfaces or with materials below 40° F.

Class B: For use on surfaces or with materials between 40° F and 60° F.

Class C: For use on surfaces or with materials above 60° F.

(B) EPOXY ADHESIVE.

(1) For Bonding New PCC to Existing PCC. Epoxy resin for bonding new PCC to existing PCC shall conform to the requirements of ASTM C 881, Type V, Grade 1 or 2, Class B and C.

(2) For Embedment of Dowels and Anchor Bolts in Drilled Holes in Existing PCC.

(a) In cases where drilled holes are positioned such that the liquid epoxy material will not run out, epoxy resin adhesive for embedment of dowels and anchor bolts in drilled holes in existing PCC shall conform to the requirements of ASTM C 881, Type IV, Grade 1 or 2, Class B and C.

(b) In cases where drilled holes are positioned such that the liquid epoxy material would run out, epoxy resin adhesive for embedment of dowels and anchor bolts in drilled holes in existing PCC shall conform to the requirements of ASTM C 881, Type IV, Grade 3, Class B and C.

(3) For Repair of Cracks by Injection of Epoxy Resin Adhesive.

(a) Epoxy resin adhesive for surface sealing cracks prior to epoxy injection shall conform to the requirements of ASTM C 881, Type IV, Grade 3, Class B and C.

(b) Epoxy resin adhesive for epoxy injection into cracks shall conform to the requirements of ASTM C 881, Type IV, Grade 1, Class B and C.

(C) EPOXY MORTAR Epoxy resin adhesive for preparing epoxy mortar shall conform to the requirements of ASTM C 881, Type IV, Grade 1, Class B and C. Fine aggregate for epoxy mortar shall conform to 803.06.

Pourable epoxy mortar shall consist of one part epoxy resin adhesive and one part by volume dry fine aggregate; trowelable epoxy mortar shall consist of one part epoxy resin adhesive and three parts by volume dry fine aggregate.

(D) CERTIFICATION The manufacturer shall certify that epoxy resin adhesive meets the requirements of this specification. Certification shall consist of a copy of the manufacturer's test results and a statement by the manufacturer that the material represented by lot or batch number has been sampled and tested, meeting the requirements of this specification. The statement shall indicate the date of testing and shall be signed by an authorized agent of the manufacturer of formulator.

821.11 GEOTEXTILE FABRICS AND MEMBRANES

Geotextile fabrics used for subsurface drainage, erosion control, sediment control and as a permeable separator, including filter fabric, shall meet the materials and certification requirements of AASHTO M 288. Fabric used for subsurface drainage shall be of the non-woven type with a minimum flow rate of 0.1 gallon per square foot per minute and minimum tensile strength (20 percent elongation) of 25 lbs./linear inch for standard strength and 50 lbs. per linear inch for extra strength.

821.12 CONCRETE SEALANTS

Concrete sealants shall meet the requirements herein and shall be delivered with certification including test results in conformance with these specifications.

(A) BOILED LINSEED OIL. Boiled linseed oil shall meet the requirements of AASHTO M 233.

821.13 LOOP SEALANT

The loop slot sealant shall be a one-component, moisture- curing, flexible polyurethane, formulated to encapsulate loop wires embedded in asphaltic cement and portland cement concrete pavements. The sealant shall remain flexible at all temperatures of -40° F and higher to protect the wire or cable from the stress of pavement movement. The flow characteristics of the sealant shall allow full depth wire

encapsulation and resist flow-out on inclined roadways. Application equipment shall be capable of filling slots from the bottom up.

The sealant shall permit the roadway to be opened to traffic over the slot immediately after application without tracking, sticking to vehicle tires, or pulling out of the slot. The cured sealant shall have the following performance characteristics when tests are conducted on deaerated, 20 mil (0.020 inch) thick, dry film liquid immersion, after curing for 28 days at 77° F.

DESCRIPTION	SPECIFICATION LIMITS	TEST AND TEST CONDITIONS
Hardness (Indentation)	65- 85	ASTM D2240 Rex, Type A, Model 1770, @ 77° F and 50% relative humidity.
Tensile Strength	500 psi, (minimum)	ASTM D412 Die C, pulled at 20 fpm.
Elongation	400%, (minimum)	ASTM D412 Die C, pulled at 20 fpm.
Flex	No Cracks at -40° F	25 Mil Free Film Bend (180 degrees) over 1/2 inch mandrel.
Weathering Resistance	Slight Chalking	ASTM D8122 Weatherometer, 350 hours. Cured 7 days @ 77° F and 50 percent relative humidity.

821.14 WOOD

Unless otherwise specified wood and wood products shall meet the specification requirements of AASHTO M 168 for the grading and classification required.

(A) WOOD FOR PERMANENT TYPE WOODEN BARRICADE. Posts and rails shall be of the dimensions shown on the plans and shall be finished lumber, either dense southern pine or dense douglas fir of minimum stress grade 1400 psi.

(B) WOOD FOR PARK TYPE WOODEN GUIDE RAIL. The timber for rails and posts shall be dense southern pine or dense douglas fir, of minimum stress grade 1400 psi, rough sawn with scantness not exceeding 1/2 inch in any dimension, and pressure treated. No boxed heart pieces shall be allowed for posts and rails of douglas fir. Boxed heart pieces are defined as timber so sawed that at any point in the length of a sawed piece the pith lies entirely within the four faces. The timber shall be air seasoned or artificially seasoned until the amount of moisture in the wood will not prevent the adequate penetration and retention of the specified amount of preservative.

Pressure treatment shall be per 811.09(A).

(C) WOOD FOR TIMBER GROUND MOUNT SIGN POSTS. Timber posts shall consist of douglas fir or southern yellow pine, coast region, select structural grade, or approved equivalent, meeting requirements of AASHTO M 168, seasoned, treated, and painted in conformance with plans and these

specifications. Grading shall strictly meet requirements of the Western Pine Association, except that boxed-heart wood will not be permitted.

Preservative for treatment shall be per 811.09(C).

(D) WOOD FOR TREE SUPPORT STAKES. Stakes for tree support, bracing, and deadmen shall be rough cypress, cedar, locust or other approved wood, free from unsound and loose knots, rot, cross grain, or other defects that may impair strength of stake. All portions of wood stakes in contact with, or under, the ground shall be treated with an approved preservative. Exposed portions of wood stakes shall be stained an approved green color. Cedar stakes shall be round with bark intact; stain or preservative is not required.

821.15 RAISED REFLECTIVE MARKERS

(A) PAVEMENT MARKERS. Pavement markers shall be raised, single or double faced, either direction plowable and all-weather reflective. Markers shall consist of a replaceable prismatic retroreflector set in a steel protective saddle encased in concrete. The marker shall be fastened to the road surface with an epoxy adhesive compound recommended by the marker manufacturer.

(1) CASTING. The casting shall weigh not more than 4 pounds and its overall dimensions shall be approximately 8 inches long by 6 inches wide by 2 inches high. It shall be shaped to deflect the blade of a snowplow driven from either direction. The surface of the casting shall be free of scale, oil, dirt, or any contaminant which might reduce the bond to the pavement materials. Casting shall be marked with manufacturer's name and model number.

The steel protective saddle for the reflector shall be of abrasive resistant steel plate, AR 360 or AR 380. The crossbar shall be of 1 inch by 0.125 inch stock, and the longitudinal bars shall be at 1 inch by 0.375 inch stock.

The concrete shall consist of 1 bag of Type III Portland cement, 4 bags of Taggart Special sand, 3 gallons of water, one fluid ounce of air entraining admixture, and 15 fluid ounces of Mighty 150 Superplasticizer. This mixture will make 63 units. The concrete shall be mixed for 3 minutes minimum and vibrated for not less than 5 seconds.

(2) REFLECTORS.

(a) Design and Fabrication. Reflectors shall consist of an acrylic plastic shell filled with tightly adherent potting compound. The shell shall contain one prismatic reflective face as required to reflect incident light from a single direction. The outer surface of the shell shall be smooth except for purposes of identification.

The reflector shall be in the shape of a shallow frustrum of a pyramid. The bottom of the reflector shall be equipped with pressure-sensitive adhesive to permit its attachment to the primed surface of the casting. Dimensions of the reflector shall be 4 x 2 x .460 inches. The slope of the reflecting surface shall be 30 degrees and the area of the reflecting surface shall be 1.7 square inches.

(b) Materials. The shell shall be molded of methyl methacrylate conforming to FS L-P-380A, Type 1, Class 3. Filler shall be a potting compound selected for strength, resilience, and adhesion adequate to pass the necessary physical requirements.

The adhesive shall be pressure-sensitive, 100 percent solid, .040 inch thick with closed cell release paper on the bottom. Pressure-sensitive adhesive shall possess adhesion and physical qualities necessary to pass test requirements as specified in 821.15(A)(3)(c).

(c) Physical Requirements and Testing for Reflectors. From the markers supplied a random sample of 10 shall be selected. A reflector shall be placed top side up on a steel plate not less than 1/2 inch thick. The load to the top of the marker shall be applied slowly through a 1 inch diameter, one 1 inch high metal plug, centered on top of the marker.

Breakage or deformation of the marker at any load less than 2000 pounds shall constitute failure of the marker. Failure of more than six of the markers shall be cause for rejection of the lot.

(d) Optical Requirements.

(i) Definitions.

Horizontal Entrance Angle - The angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the reflector.

Observation Angle - The angle at the reflector between observer's line of sight and the direction of the light incident to the reflector.

Specific Intensity (S.I.) - The candlepower, in foot-candles, of the returned light at the chosen observation and entrance angle for each foot candle of illumination at the reflector on a plane perpendicular to the incident light.

(ii) Optical Performance.

Steel Wool Abrasion Procedure - Form a 1 inch diameter flat pad using #3 coarse steel wool per FS FF- W-1825. Place the steel wool pad on the reflector lens. Apply a load of 50 pounds and rub the entire lens surface 100 times.

Specific Intensity - After abrading the lens surface, using the above steel wool abrasion procedure, the specific intensity of each crystal reflecting surface at 0.2 degrees observation angle shall not be less than the following, when the incident light is parallel to the base of the reflector:

HORIZONTAL ENTRANCE ANGLE	S.I.
0 degrees	3.0
20 degrees	1.2

For yellow reflectors, the specific intensity shall be 60 percent of the value for clear crystal.

(iii) Optical Testing Procedure. A random lot of 10 reflectors shall be tested. The reflector to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inches.

The photocell width shall be an annular ring .37 inch I.D., or .47 inch O.D. It shall be shielded to

eliminate stray light. The distance from light source center to the photocell center shall be 0.21 inches. If a test distance of other than 5 feet is used, the source and receiver dimensions and the distance between source and receiver shall be modified in the same proportion as the test distance.

Failure of more than 6 of the reflecting faces tested shall be cause for rejection of the lot.

(3) REFLECTOR BONDING. Fastening shall be accomplished by bonding the reflector to the casting through use of the pressure-sensitive tape permanently adhered to the reflector. Bonding shall be done at ambient temperatures of 50° F (10° C) or higher.

(a) Casting Preparation. Clean casting in reflector pad area. Apply a thin coat of primer to clean, dry area and allow it to dry.

(b) Bonding Reflector. Remove the reflector release paper from the bottom of the reflector and place the reflector on the casting with the proper lens facing traffic. Apply a load of 1,000 pounds to 2,500 pounds for 3 seconds minimum.

(c) Pressure-Sensitive Adhesive.

(i) Strength Requirements. Pressure-sensitive adhesive, when applied with minimum application pressure of 60 psi must possess a minimum tensile or shear strength of 15 psi at 70° F (21° C) ambient temperature.

(ii) Strength Testing Procedure. A standard 4 x 2 x .46 inch reflector with pressure-sensitive adhesive on the bottom shall be adhered to appropriate flat 12 inch carbon steel test plate, properly primed, with 60 psi minimum application pressure. Both the top of the reflector and the bottom of the flat plate shall have fastened to it an appropriate coupling device to ensure compatibility with the tensile testing device. The test sample shall be tested in the tensile mode at 2"/minute pull rate. Minimum load to produce failure shall be 125 pounds at 70° F (21° C). Any figure below 125 pounds constitutes system failure.

(d) Primer.

(i) Strength Requirements. The primer shall provide for the proper surface condition to promote optimum adhesion between the substrate and pressure-sensitive adhesive.

(ii) Strength Testing Procedures. Prime test plate with primer and allow to dry. Apply pressure-sensitive adhesive between primed test plates with 60 psi application pressure. The primer shall be judged as acceptable if after subjecting specimen to tensile loading at 70° F (21° C) ambient, the failure is cohesive.

(B) BARRIER MARKERS. The marker shall consist of an ABS housing with a flat acrylic plastic retroreflective lens, hermetically sealed to it, capable of reflecting incident light from wide angles. The marker shall be mounted to the top or side of the barrier with a butyl pad, epoxy or solvent cement.

(1) PHYSICAL REQUIREMENTS. The marker shall be white and the reflective surface shall be either crystal or yellow. The housing dimensions shall be approximately 3 inches high, 5-1/4 inches wide and 2-1/2 inches deep. The projected reflecting surface area shall be approximately 9.5 square inches. The body surface shall be smooth, except for identification, to facilitate self cleaning.

The material for the housing shall be acrylonitrile butadiene styrene (ABS). The material used for the reflective area shall be methyl methacrylate plastic and must conform to FS LP-380C, Type 1, Class C.

After exposure for one hour to an ambient temperature of 125° F (52° C) maximum the assembly shall meet all optical and physical requirements.

(2) OPTICAL REQUIREMENTS.

(a) Definitions.

Horizontal Entrance Angle - The angle in the horizontal plane between the mounting plane (concrete barrier) and the incident light. The horizontal entrance angle shall be considered as plus in the direction from the mounting plane toward the normal to the reflector face. Only plus angles shall be measured.

Observation angle - The angle formed between the line from the light source to the reflector and the line from the reflector to the observer's eye.

Specific intensity - The candlepower, in foot-candles, of the returned light at the chosen observation and entrance angles for each foot candle of illumination at the reflector face on a plane perpendicular to the incident light.

(b) Optical Performance. When the marker is oriented in the photometric device with its long axis vertical and mounted to simulate mounting on the vertical side of a concrete barrier, the specific intensity of the crystal (white) reflecting surface at 0.1 degree observation angle shall be as follows:

HORIZONTAL ENTRANCE ANGLE	SPECIFIC INTENSITY
+ 0 degrees	140
+ 20 degrees	55

For yellow markers, the specific intensity shall be 60 per cent of the value for white.

(c) Optical Testing Procedure. The markers to be tested shall be located with the center of the reflective area at a distance of 100 feet from a uniformly bright light source having an effective diameter of 2 inches. The photocell shall have an aperture of 0.5 inch diameter, and shall be shielded to eliminate stray light. The distance from the center of the light source to the center of the photocell aperture shall be 2.09 inches. If a test distance of other than 100 feet is used, the source and receiver dimensions along with the distance between source and receiver shall be modified in the same proportion as the test distance. In no case shall the test distance be less than 10 feet.

Determination of acceptability shall be based on MIL- STD-105D using an AQL of 2.5.

(d) Marker. Barrier markers such as Model H962 manufactured by the Signal Products Division, Amerace Corporation 7542 No. Natchez Street, Niles, Illinois 60548; Models JD-1 or JD-2 as manufactured by Astro Optics Corporation, 924 Morse Street, Schaumburg, Illinois 60192; or approved equivalent are acceptable.

(C) GUARDRAIL MARKERS. The guardrail marker shall consist of an ABS housing with a flat acrylic plastic retroreflective lens, hermetically sealed to it, capable of reflecting incident light from very wide angles. The housing shall be attached to the guardrail with butyl pads, epoxy or solvent cement.

(1) PHYSICAL REQUIREMENTS. The marker shall be white and the reflective surface shall be either crystal or yellow. The housing shall be approximately 5-5/16 inches high, 2-3/8 inches wide and 15/16 inches deep. The projected reflecting surface shall be a minimum of approximately 6-1/2 square inches.

The 1/2 inch x 3-1/2 inch wing of the device will emit a signal from -5 degrees to +70 degrees. The wide angle reflector performance shall be retained in all conditions, rain, fog, or snow.

The material for the housing shall be acrylonitrile butadiene styrene (ABS). The material used for the reflective area shall be methyl methacrylate plastic and conform to FS-LP-380C, Type 1, Class C.

(2) OPTICAL REQUIREMENTS.

(a) Definitions.

Horizontal Entrance Angle - The angle in the horizontal plane between the mounting plane (guardrail) and the incident light. The horizontal entrance angle shall be considered as plus in the direction from the mounting plane toward the normal to the reflector face.

Observation angle - The angle formed between the line from the light source to the reflector and the line from the reflector to the observer's eye.

Specific Intensity - The candlepower, in foot-candles, of the returned light at the chosen observation and entrance angles for each foot candle of illumination at the reflector face on a plane perpendicular to the incident light.

(b) Optical Performance. When the marker is oriented in the photometric device with its long axis vertical and mounted to simulate mounting within a guardrail, the specific intensity of the crystal (white) reflecting surface at 0.1 degree observation angle shall be as follows:

HORIZONTAL ENTRANCE ANGLE (degrees)	SPECIFIC INTENSITY
-5 (OR)	10
0 (HV)	20
+5 (RS)	20
+10 (RS)	20
+20 (RS)	20
+45 (RS)	25
+50 (RS)	25
+70 (RS)	10

Note: OR - Off Roadway Side
RS - Roadway Side
HV - Horizontal, Vertical axis of reflector

For yellow markers, the specific intensity shall be 60 per cent of the value for crystal (white).

(c) Optical Testing Procedure. The markers to be tested shall be located with the center of the reflective area at a distance of 100 feet from a uniformly bright light source having an effective diameter of 2 inches. The photocell shall have an aperture of 0.5 inch diameter, and shall be shielded to eliminate stray light. The distance from the center of the light source to the center of the photocell aperture shall be 2.09 inches. If a test distance of other than 100 feet is used, the source and receiver dimensions along with the distance between source and receiver shall be modified in the same proportion as the test distance. In no case shall the test distance be less than 10 feet.

Determination of acceptability shall be based on MIL- STD-105D using an AQL of 2.5.

(d) Marker. Guiderail markers such as Model #962 manufactured by the Signal Products Division, Amerace Corporation 7542 North Natchez Street, Niles, Illinois 60548; Model GR-1 as manufactured by Astro Optics Corporation, 924 Morse Street, Schaumburg, Illinois 60193; or approved equivalent are acceptable.

821.16 IMPERVIOUS SUBGRADE MATERIAL

Polyethylene sheeting used as an impervious subgrade material shall conform to the requirements of AASHTO M 171 except the color shall not be restricted and the moisture retention and apparent daylight reflectivity requirements will not apply. The average thickness of the sheeting shall not be less than one mil (0.001 inch).

821.17 FORMULATED LATEX MODIFIER

Latex shall be a non-toxic, film forming, polymeric emulsion to which all stabilizers have been added at the point of manufacture and shall be homogeneous, uniform in composition, and free from chlorides. The latex modifier shall conform to the following requirements:

POLYMER TYPE	STYRENE BUTADIENE
	68 ± 4 Styrene
	32 ± 4 Butadiene
Average Polymer	
Particle Size	1500 to 2500 Angstroms
Emulsion Stabilizers	Anionic and non-ionic surfactant
Percent Solids	46.5 to 49.0
Weight (lbs. at asc)	8.40 to 8.55
per gallon	
pH	9 to 13
Shelf Life	2 years
Color	White

Each shipment of latex modifier shall be accompanied by a report of tests performed in accordance with the Certification Program contained in Section VII of Report No. FHWA- RD-78-35. The report shall include date of manufacture, batch or lot number(s), quantity represented, manufacturer's name, place of manufacture, and the date on which the one- year certification period will expire.

821.18 PIPE JOINTING COMPOUND

(A) **PHYSICAL PROPERTIES.** Pipe jointing compound shall have a bituminous base and shall adhere firmly to the glazed surface of pipes. It shall melt freely at 250°F. When set hard it shall be sufficiently elastic to permit a slight movement of the pipe without injury to the joints or breaking of the adhesion of the compound to the pipes.

(B) **CHEMICAL PROPERTIES.**

	<i>Minimum</i>	<i>Maximum</i>
Specific gravity at 77°F.....	1.00	1.50
Bitumen soluble in CS ₂ percent.....	50	-----
Loss in weight, 5 hrs., 50 gm at 400°F	-----	1.00
Melting point (Ring and Ball), °F	200	-----

The compound must withstand five (5) days immersion in five (5) percent solution of KOH and five (5) days immersion in one (1) percent solution of HCl.